Image Retrieval from Video Streams Databases using Similarity of Clustering Histogram

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Abstract

The recent system for image retrieval based on histogram of clustering idea which considers the likeness among database of images is suggested. Firstly, the space of image's feature is compressed using Haar transform. Secondly points of interest were detected from wavelet image, and then those points of interest was descriptor using SURF descriptor Thirdly, the clustering algorithm of moving k-means is employed for features cluster that resulted from SURF descriptor and then a histogram was built from the cluster's values. The suggested procedure is experimented on different database. The outcome of experimental shows that suggested procedure is reliable, fast and active for retrieving of an image from database based on histogram than FAST detection of corner that depend on image features.

Keywords: Haar transform, feature space, FAST, SURF descriptor, moving k-means clustering histogram

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1. Introduction

Collections of digital images are constantly growing today. Numerous of image scan be created daily; therefore, for rapid and preferable retrieval, a suitable arrangement of images is needed. For such intention systems of retrieval of an image are prepared [1] . The detect image becomes significant because of publicity of different search engines of an image [2]. Retrieval of an image is procedure for recovering image from images' database. Images' locations based on keywords which were ready by an annotator for recovering such image in future and one own to utilize such keyword. A substantial benefit of above mechanism is that perfect decided styles and simple for understanding how ever there are difficulties; while database's size is huge, and manually large quantity of work is needed to comment the images. The language and culture difference are another difficulties because of which identical image is generally text out through multiple various methods and errors like the error of spelling or like spell various will obtain outcomes [3]. To copes these troubles numerous techniques in CBIR were advanced and numerous CBIR systems can be established.

The maximum low level collective characteristics of an image are shape color, and texture. Image's characteristics are automatically elicited depend on query via paradigm wherever query is an image of which characteristics can be elicited and it can compare with characteristics of images in a database and depend on that it can be can be retrieved an appropriate images [4].

Various ways can be employed for each characteristic representation. Every way has advantages and disadvantages [5]. Depending on requests and implementation better method can be chosen from these. CBIR systems have great number of implementations such as prevent the crime, teaching and training, application of military, diagnosis of medical and style and internal design.

2. Related Work

Meng and Chakravarti have suggested mechanism in 2010 for retrieval an image based on histogram of color [2]. The process of this mechanism is effective and simple. Retrieval of an image based on content using characteristic of shape and texture is suggested by Dais [3]. Morphological closing operation combined with filter of Gabor can be employed to elicit feature's texture. A feature of shape is elicited using Descriptor of Fourier.

Color and feature of texture can be used by Buch [4] for retrieval of an image which employs color moment to elicit the feature of color and combined Gabor with wavelet for the feature of texture. The retrieval system of an image based on content is explained by Pujari[6] depending on feature of shape and color. The color space Hue, Saturation and Value (HSV) was introduced by the system. Deselaers[7] is introduced flexible engine system for retrieval an image retrieval This system is more extensible that suggested broad kinds of features and functions of distance. Weighed merge of features can be employed based on requirement. The system of Photobook is introduced by Petland [8] which is employed for images' searching and browsing. A system is totally flexible and lets text based as long as retrieval based content. An interactive interface for the user can be provided by this system. A system for detection of image's shape is described by Acharjya [9]. The system uses mask of Prewitt's to discover an image's edge. Numerous of the present mechanisms for retrieval of an image based on contents has trouble of time computation is high because of comparison all images in database with image of query. Accuracy is not very good in some systems is other trouble.

3. Proposed Methodology

The suggested system in this paper for retrieval an image based on histogram of clustering idea which looks the likeness among database of images. To cluster the images in database, the suggested method employs the clustering algorithm of moving k-means. First video frames series can be taken. An image color space can be compressed by applying Haar transform. Secondly, the feature of interest is elicited using FAST corner detection. After eliciting interest features from all images, the interest features could be described using SURF descriptor. The algorithm of clustering that using moving k-means is employed for described features clustering. A query histogram can be offered as entry and the numbers of features are elicited from a query histogram. X-axis of histogram represents the cluster number and y-axis represents the number of features in each cluster. The elicited numbers of features are matched with every video frame histogram using Manhattan distance and discover the similar histogram to query histogram. After chosen similar histogram, it can retrieve numbers of images from that video frames as outcomes of images. Figure 1 displays block diagram of the system for retrieve an image in a proposed method.

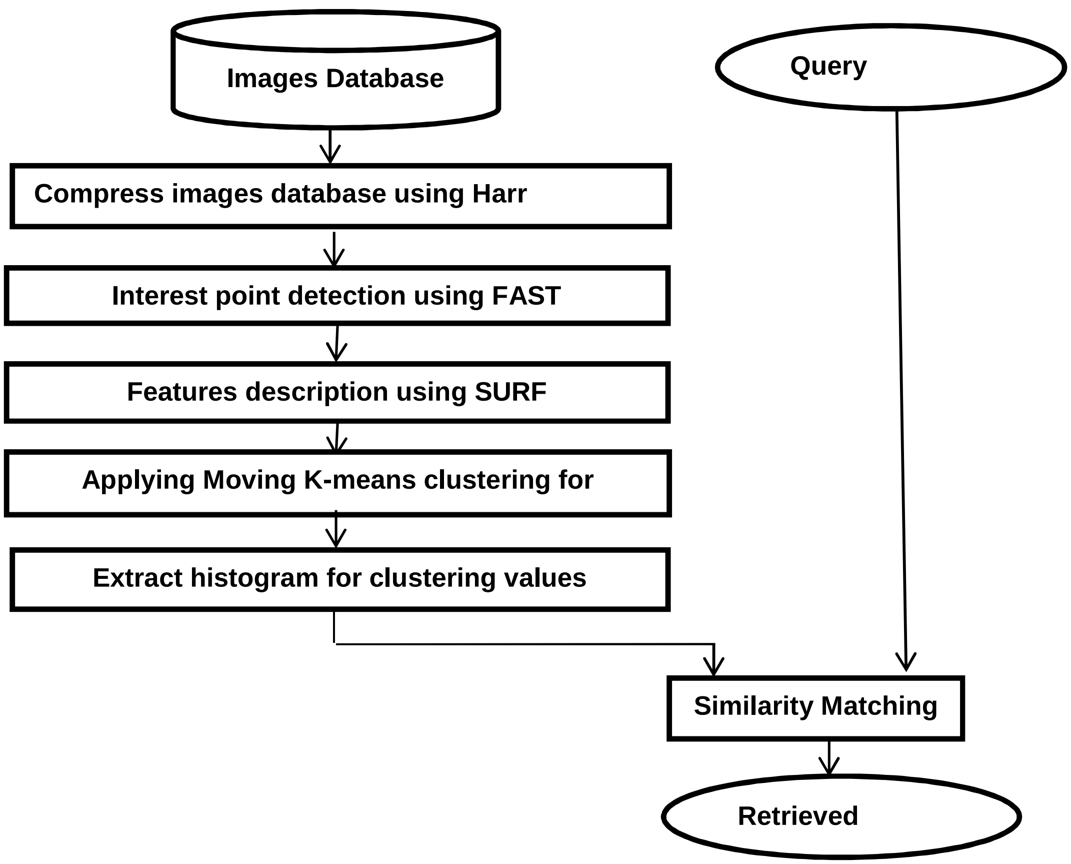


Figure1: Block diagram of proposed system for retrieving an image

3.1 Wavelet Transform

Wavelet transforms anchor on sub-sampling low pass and high pass filters (Quadrature Mirror Filters (QMF)). By splitting the data into low pass band

and high pass band with or without losing any information, matching the filters is done.

Wavelet filters can be organized for applications of a broad range and numerous different sets of filters can be proposed for various applications. Wavelets are functions identified through a limited interval. A wavelet transform can be employed for a data transform from Time-space domain into Time-frequency domain that can perform best compression outcomes [10]. Haar wavelet is a straightforward situation of wavelets as clarified in bellow function:

$$\varphi(x) = \begin{cases} 1 & 0 \le x < 1/2 \\ -1 & 1/2 \le x < 1 \\ 0 & \text{otherwise} \end{cases} \quad \dots (1)$$

Bellow an example to implement Haar Transforms:

137	134	129	131
135	141	133	132
138	134	134	131
135	129	133	131

1	1	0	0
1	-1	0	0
0	0	1	1
0	0	1	-1

LL		HL	
136	131	-1	0
134	132	5	2
LH		**HH**	
-3	-2	9	-3
4	0	-2	1

The four bands are indicates to Low-Low (LL), Low-High (LH), High-Low (HL) and High-High (HH). It can potential to implement group of wavelet filters on LL band with self-path as implemented to the main image because it contains image-like information. An image dividing operation into sub-bands can be permanent for resolution of an image, probably for compression of an image and it is commonly continued for 4 levels or 5 levels.

3.2 Haar Transform Model

Haar transform is the simplest compressions process that useful energy. This transformation a vector $(x\ (1)\ x\ (2))^T$ to $(y\ (1)\ y\ (2))^T$ in dimension by employment the bellow equation:

$$\begin{bmatrix} X(1) \\ X(2) \end{bmatrix} = T \begin{bmatrix} Y(1) \\ Y(2) \end{bmatrix} \quad \dots (2)$$

Where $T = \frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$, Y (1) and Y (2) represent the sum and difference of X (1) and X (2) and scaled by $\frac{1}{\sqrt{2}}$ to maintain energy

Because T rows are orthogonal to each other, T is an orthogonal matrix and they can be normalized to unit magnitude. Therefore

$$T^1 = T$$

It can recover X from Y using (3) (In this case T is symmetric to T^1=T)

$$\begin{bmatrix} X(1) \\ X(2) \end{bmatrix} = T^T \begin{bmatrix} Y(1) \\ Y(2) \end{bmatrix} \quad \dots (3)$$

x and y become 2*2 matrices in 2-dimensional. First column of x can transform via pre-multiplying by T, and then the rows of outcome by post-multiplying by T^T [11]. Hence

$$Y=TXT^T \quad \ldots (4)$$

And to invert

$$X=T^T YT \quad \ldots (5)$$

Equations bellow show what is happening

$$x = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

$$x = {}^1/_{\sqrt{2}} \begin{bmatrix} a+b+c+d & a-b+c-d \\ a+b-c-d & a-b-c+d \end{bmatrix}$$

Top Left: a+b+c+d represent 2-D low pass (L0-L0) filter or average of 4-point.

Top Right: a-b+c-d represent a filter of highpass at horizontal and lowpass at vertical (Hi-L0) or average horizontal gradient.
Lower Left: a+b-c-d = horizontal lowpass and vertical high pass (L0-Hi) filter or average vertical gradient.
Lower Right a-b-c+d = 2-D Highpass (Hi-Hi) filter or diagonal curvature.
The pixels are gusseted into 2*2 blocks and implement (Eq.4) to each block to implement this transform to an entire image. After reordering, the result is illustrates at figure (2).

a) b)
Figures 2: a) Original image b) Two Dimensional Haar Wavelet

For seeing the outcome sensibly, it has gusseted in figure 2(b) all sub image's top left and act the oneself of other 3 positions of the components to form the corresponding other 3 sub images.

3.3. Feature Detection Using FAST

The standard computers have fast processing power enough for corner extraction at the rate of video. However, running traditional algorithm for corner detection such as the detector by Harris algorithm and performing heavy tasks make impossible computation on one processor. At the introduction of modern algorithms like FAST (Features from Accelerated Segment Test) [12], elicitation the feature consider great increase for the performance of computer vision applications in real-time. The FAST was depending on the SUSAN detector. A circular region's center can be used for defining neighboring brighter and darker pixels.
FAST algorithm doesn't evaluate the whole circle's region, but only the pixels on discretization circle for segment's characterization. SUSAN likes FAST uses a Bresenhams algorithm for circle drawing with diameter of 3.4 pixels for trial mask. Trial 16 pixels compared to the nucleus's value for a complete accelerated segment. The criterion of corner should be more relaxed to block this broad trial.

A pixel's criteria must be a corner based on the accelerated segment test (AST) which there must exist at least S pixels that have more brilliant circle connection or darker than a threshold designer by the center pixel value. Other values of 16 pixels are disregarded. So the value of S can be used to determine the detected corner at maximum angle [12].

3.4 Improvement of FAST Algorithm for Corner Detection to Reduce Feature Space

To reduce an image's feature space, an adaptive threshold thr is used with FAST algorithm which is improved in different contrast of an image and can be illustrated by Eq. (6)

$$thr=(Img_{max} - Img_{min})/2 \quad \dots (6)$$

where Img_{max} and Img_{min} are the largest and smallest gray value of whole image.

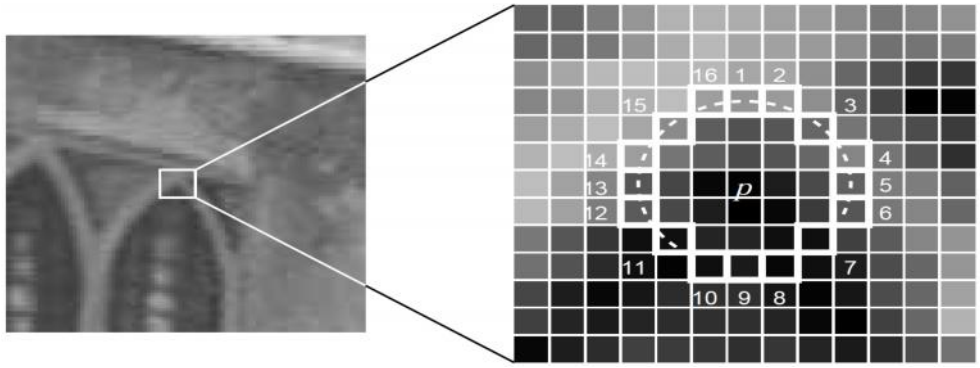


Figure 3: Image display the point of interest under a test and the circle of 16 pixels

The steps of FAST algorithm can exposure below:

1. From an image, chose a pixel p". I_P represent pixel's intensity. This pixel can be specified as a point of interest or not. (returning to fig.3).

2. Get thr from Eq. (6) that represents the value of threshold intensity.
3. Assume periphery a pixel p the circle of 16 pixels. (a Bresenham circle [4] of radius 3.)
4. Need "N" exposure near by pixels far from the 16 pixels, either below or above I_P by thr value, if the pixel wants to discover as a point of interest.

5. First match 1, 5, 9 and 13 of the circle pixels' intensity with I_P to make an algorithm fast. From the up figure, at least three of these four pixels should accept the norm of the threshold for this it subsist an interest point.
6. P is not an interest point (corner) if at least three values of - I_1 ,I_5 ,I_9 I_{13} are not below or above I_P+thr. For this a pixel p can be rejected as a potential point of interest. Else if three pixels at least are up or down I_p+thr, for whole 16 pixels seek and check if 12 neighboring pixels drop in the norm.
7. A same procedure can iterate for whole image's pixels.

3.5 Feature Description Using SURF Algorithm

The significant job of computer vision is correspondence matching, and in changing medium wherever an enlargement, rotation, position point and lightening are modified, it is not easy to determine corresponding points.
SURF (Speeded Up Robust Features) can be widely employed for problem solving of the correspondence identity due to it was faster than SIFT (Scale Invariant Feature Transform) by briefness for showing of matching.
To find candidate points, SIFT uses visual pyramids and based on the law of Gauss filters each layer with raise values of Sigma and determines differences.

For image identification and matching, the proposed algorithm employs SURF descriptor for feature. Vectors of feature are elicitation by SURF which is stable to image rotation and scaling. Features can be matched using Manhattan distance measure. Local descriptors of SURF are better in computational efficiency than local descriptors of SIFT because of integral images computed in SURF. At discrete locations, points of interest are chosen in the image such as corners. Every key point's neighborhood is represented by a vector of feature. The descriptor of feature has to be discriminative, strong to noise, errors' detection, deformations of geometric and photometric. Finally the vectors of SURF descriptor are matched between various images. The matching is based on Manhattan dissimilarity.
To build feature space, SURF algorithm consists of various stages. These stages are detection of interest point, for each key point, SURF descriptor must be build, and descriptor matching [13].

3.5.1. Constructing Integral image
For SURF speed, integral images can be calculated. Image of integral is an intermediate representation and construct from the summation of image pixel values. It is also called as Summed Area Tables [12]. Integral image can be is given by (7).

$$U(x,y) = \sum_{i \le x, j \le y} u(i,j) \qquad \dots (7)$$

Where u(i,j) represent the feature at location i and j ,U(x,y) represent the feature of integral at x and y locations.

3.5.2 Interest Point Detection

Fast Hessian feature detector can be used in SURF .It is based on the determinant of Hessian matrix. Hessian matrix consists of partial derivatives of two dimensional functions.

Our algorithm uses FAST corner detection with adaptive threshold for detection the interest point and can be used in applications of real time as illustrated in section 3.4.

3.5.3. Descriptor with SURF

Because SURF is stable to rotation, rotation can be processed by determining feature's direction rotating the sampling of window to adjacency together for this angle. Build quadrate area position on feature's point. Window volume that can take about the discovered interest point is 20sX20s, s represents the volume.

When the rotated nearness is finding, it splits into 16 sub quadrates. Again every sub quadrates can be divided into 4 quadrates [14].

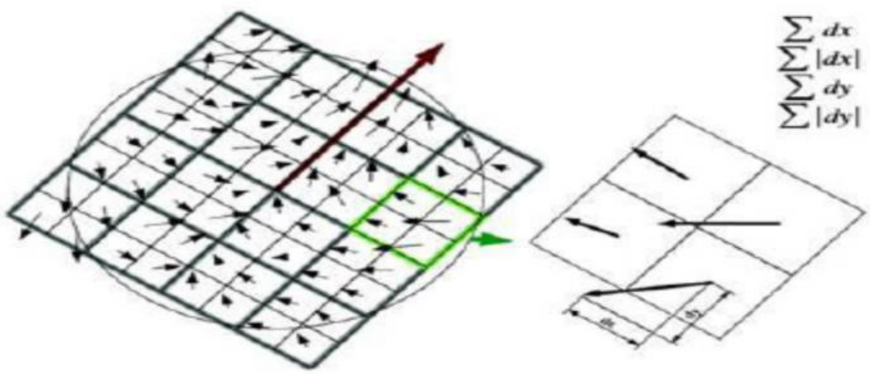


Figure 4: schematic impersonation for SURF descriptor

3.5.4. Computation for Descriptor

It computes Haar wavelet responses in horizontal and vertical directions for each sub-region and summation of dx, |dx|, dy, |dy| is formed and put in a vector V. For final squares, it can be possessed the derivatives in the x and y directions. The x derivatives summation over its four quadrants and for y derivative is representing a descriptor for sub square. It has 4 values for total descriptor. For length equal 1, it can normalize V and feature's descriptor. A vector supplies the descriptor for feature of SURF with aggregate 64 dimensions. It can provide better discriminative for features in lower dimension, with maximum computation's speed and matching [14].

4. Database Clustering

Clustering means collect elements of data from a data set to clusters of several likeness norms.

In CBIR systems likeness among the database of images is not see just the likeness between database images and query image that is used for retrieval [15].

In this trouble of imposing computation time which is existing because comparison of features of query image with all images features in database. Clustering is employed to decrease the time of computation which considers likeness among the database images. There is no requiring after clustering for query image comparison with all images in database which decreases the time of computation and accuracy improvement. The algorithm of clustering for k-means is very straightforward for execution. The generations of clusters are not perfect in quality and time consuming for clusters generation is very imposing which is the problem in this way.

An algorithm of clustering with moving k-means provides perfect time consuming and well clusters' quality to introduce cluster is less than the algorithm k means [16]. An algorithm of clustering with moving k-means has been employed.

1) The user has been specified the number of coveted clusters as input.

2) The set of features that resulted from SURF descriptor are split randomly into number of coveted clusters based on Variance. The variance also tells something about the contrast.

$$variance = \sqrt{\sum_{g=0}^{L-1}((g - Mean)^2 * p(g))} \quad ...(8)$$

L :-is the total number of gray levels available , for example, for typical 8-bits image data l is 256 and range from 0 to 255.

p (g)= N(g)/X*Y

N (g):- is the number of pixels at gray level p.

P (g):- probability.

3) The midst point is treated as the cluster's centroid in every cluster. A distance among every data point to whole an initial centroid can be computed and a point of data is specified to cluster with aftermost centroid.
4) Through this, the cluster is enrolled to which data item can be specified and item distance of data for that cluster can be maintained. Cluster's centroids the can be recomputed.
5) From current after most cluster centroid ,compute a distance again for every data point if the distance is equal or lower than current nearest distance, a point of data in the selfsame cluster stays else data item distance is computed from whole the centroids.
6) The procedure continued until the convergence norm is not satisfied.

5. Histogram Overview

A histogram is a kind of graph that has broad implementations in statistics. Histograms supply a visual translation of numerical data by referencing the number of data points that Located in values' domains. These domains of values are called bins or classes. The data frequency that incidence in every class is drawn by the employ of a bar. The upper that the bar is, the maximal data values of the frequency in that bin.

5.1 Histogram Clustering Descriptor

A cluster histogram can be employed to show each cluster's features in this part. The x-axis of histogram shows the norm values into which the convenient measurements. These measurements are showing the clusters for local features of images which are aid to abstract great sets of features data.

Individual points of data are not showed and every cluster show how many features are existed at each cluster [17]. Y-Axis: Y-axis is the norm that displays you the number of times or frequency for the values of local features within each cluster.

5.2 Histogram Similarity

Matching speed of feature is performed by a unique step of indexing depend on the value of the Manhattan of clustering values.

Compute a distance that would be traveled through a Manhattan distance function to obtain with one point of data to another if a grid-like track is followed.

The distance of Manhattan among two components is the summation of differences of their corresponding items [18].

The distance's formula among a point *X*=(*X1*, *X2*, etc.) with a point *Y*=(*Y1*, *Y2*, etc.) Is:

$$d = \sum_{i=0}^{n} |x_i - y_i| \quad \text{... (9)}$$

6. Proposed Algorithm

The algorithm of the proposed technique is illustrated as:

Input :Histogram of clustering values Output :Images to be retrieved that matches the histogram of clustering values
Step1: 1.1 Enter AVI video 1.2 Covert video stream into frames *(Imgs)* Step 2: Compute Haar transform for frames(*(Imgs)* and put the result in *(H_imges)* by using Eq.*(4)* Step 3: Detect the interest points for frames and put the results in *(D_H_Imgs)* Step 4:Construct the integral images for*(D_H_Imgs)* by using Eq.(7) Step 5: compute the descriptor of features on integral images resulted from step4 for a video frames Step 6:Apply the algorithm of moving k-means clustering for all features descriptor of video frames by using Eq.(*8*) and put the result in the array *cluster_arry()* Step 7: //For retrieval 7.1 Enter the number of features for each cluster and find a histogram of these clusters. 7.2 Display all images that matching the histogram using Eq.*(9)* Step 8: end

7. Experimental Results

The outcomes of suggested method are offered and discussed at this part. The suggested method is executed in C#. Three types of databases like Women, Crocus, and Tracery from video frames are employed for evaluation the suggested mode. Database images are colored, and with size 320 × 240 pixels. Retrieval outcomes evaluation can be simply made because of this ranking. Figure 5 displays a snip of 5 images for each database.

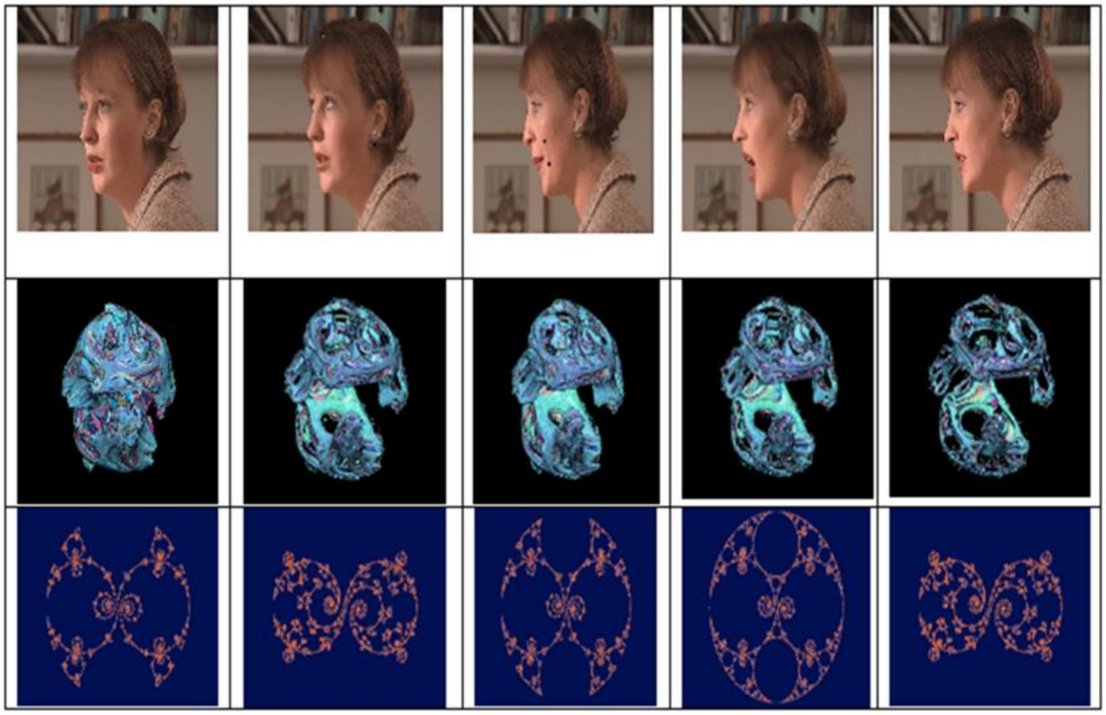


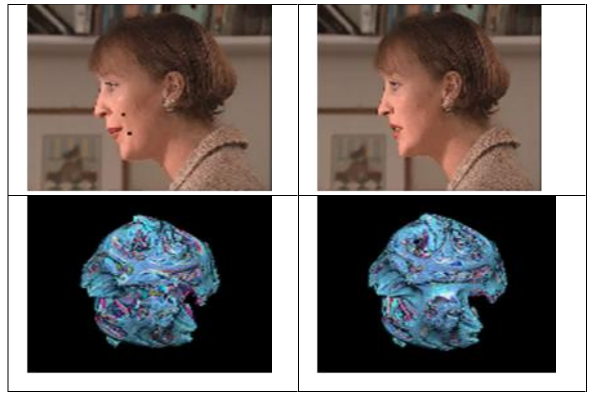
Figure 5: Sample of 5 images from three databases

Figure 6 and 7 show the entry query histogram based on clusters. Each cluster may contain or not contain features.

In figure 6(a), the cluster number (1) has no feature, cluster number (2) has four features, and cluster number (2) has five features.

Figure 6(b) explains the images that can be retrieved from Women, Crocus, and Tracery databases based on entry query histogram.

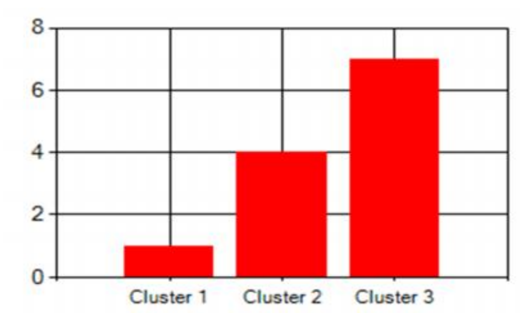
(a)



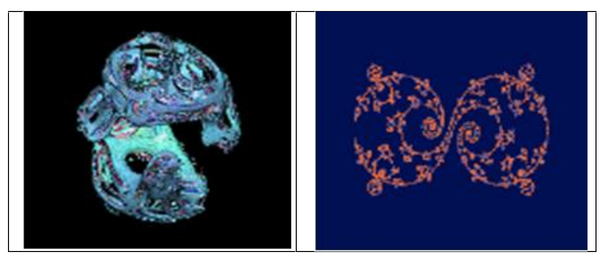
(b)

Figure 6: a) histogram query b) retrival outcomes of Women, Crocus, and Tracery of based on histogram query

In figure 7(a), the cluster number (1) has one feature, cluster number (2) has four features, and cluster number (2) has seven features. Figure 7(b) explains the images that can be retrieved from Women, Crocus, and Tracery databases based on entry query histogram.



(a)



(b)

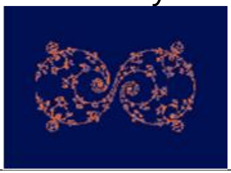
Figure 7: a) histogram query b) retrival outcomes of Women, Crocus, and Tracery based on histogram query

tain

method of FAST algorithm of detection corner for the purpose of retrieving

images in term of speed and time consuming in seconds for retrieval process.
The proposed method relied on histogram in the retrieving images process while FAST algorithm relied on corner features that can be detected from images.
From the outcomes, retrieval images of the proposed system are faster than FAST algorithm for detection corner.

Table 1: Suggested method comparison with FAST method in term of time consuming

Image category	Time consuming for FAST	Time consuming for proposed method
Women 	6.001 seconds	1.651 second
Crocus 	4.142 seconds	1.619 second
Tracery 	4.072 seconds	1.520 second

8. Conclusion

A trial can be made for similar images retrieval from the databases based on histogram similarity mode by provisioning a query histogram. This method employs the histogram of moving k-means clustering algorithm. Every cluster contains number of features that are resulted from applying SURF descriptor on interest points.

Fast corner detector can be employed for detection interest points on wavelet images. Experimental outcomes show that the suggested methodology is faster and more efficient than method that retrieves images based on feature detection using FAST algorithm.

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أسترجاع الصوره من قواعد بيانات السلاسل الفيديويه بأستخدام تشابه المخطط العنقودي

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المستخلص

ان النظام الحديث لأسترجاع الصوره مستند على فكرة مدرج احصائي عقودي (clustering) والمقترح للتشابه بين الصور في قاعدة البيانات.اولا يتم ضغط فضاء صفات الصوره بأستخدام تحويل Haar .ثانياً يتم أكتشاف النقاط المهمه في الصورة المضغوطه (wavelet) وبعد ذلك يتم وصف تلك النقاط المهمه بأستخدام الواصف (SURF) .ثالثاً خوارزمية (k-means) المتحركه تستخدم لتجميع صفات الواصف (SURF) بشكل عناقيد (clusters) وبعد ذلك يبنى مدرج أحصائي من قيم العنقود (cluster).تم تجربة الأجراء المقترح على قواعد بيانات مختلفه.تبين من النتيجه التجريبيه بأن الأجراء المقترح نشيط وسريع وموثوق لأسترجاع صوره من القاعده البيانيه بالأعتماد على المخطط الأحصائي مقارنة مع كاشف الزاويه بأستخدام (FAST) والذي يعتمد على صفات الصوره.

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